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U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NO
BAYER-3 (PCT)TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO (if known, see 37 CFR 1.5)

10/049173

INTERNATIONAL APPLICATION NO.
PCT/DE00/02693INTERNATIONAL FILING DATE
August 10, 2000PRIORITY DATE CLAIMED
Aug. 12, 1999 and Feb. 26, 2000

TITLE OF INVENTION

PLANETARY TRANSMISSION

APPLICANT(S) FOR DO/EO/US
THOMAS BAYER

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371 (f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau)
 - b. ☐ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has **NOT** expired.
 - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

PCT/ISA/210 - Int'l. Search Report
2 Sheets of Formal Drawings

Applicant Claims Priority under 35 U.S.C. §119 of Germany Application Nos. 199 38 323.5 and 100 09 205.5 filed August 12, 1999 and February 26, 2000, respectively.

Applicant Claims Priority under 35 U.S.C. §120 of: PCT No. PCT/DE00/02693 filed August 10, 2000.

PLANETARY TRANSMISSION

The invention concerns a planetary transmission according to the generic portion of patent claim 1.

A similar transmission with a two-stage design is known from EP 0 824 640 B1.

The invention concerns itself with the problem of being able to achieve a significantly greater transmission ratio and torque transfer in this type of transmission without significantly enlarging the overall volume. In addition, the stiffness of the transmission is to be elevated significantly. Furthermore, the transmission is to be economically producible with simple means and is to ensure low-wear operation and transmission with little play.

This problem is solved through the embodiment of a transmission of this type according to the characterizing features of patent claim 1.

Advisable embodiments are the object of the sub-claims.

By using four planet wheels across the width in individual transmission stages, on one hand, high torques can be transmitted in these transmission stages, and, on the other hand, the stiffness of the transmission is significantly elevated.

Unexpectedly favorable transmission ratios resulted when the transmission stages were each designed with four planet wheels in a planet carrier having a transmission ratio of $i = 5.5$, particularly when the internal gear had 108 teeth. Total transmission ratios which were even could be achieved, particularly if an odd transmission ratio $i = 5.5$ was used.

In a planetary transmission implemented in three stages according to the invention, the overall transmission ratio can be calculated according to the formula

$$i_{ov} = i_1 \times i_2 \times i_3 - (i_1 \times i_2 - 1)$$

According to this, a maximum practically achievable transmission ratio is $i = 901$.

An exemplary embodiment subsequently described in more detail is shown in the drawing.

Fig. 1 shows a schematic view of a three-stage planetary transmission,

Fig. 2 shows a planetary transmission implemented in an alternative way to the implementation shown in Fig. 1.

DESCRIPTION OF THE EMBODIMENT SHOWN IN FIG. 1

The rotatable parts of a three-stage planetary transmission are mounted inside a transmission housing 1. In the exemplary embodiment shown, the transmission gears down from left to right.

The three transmission stages are labeled with I, II, and III.

In the first transmission stage I, a first sun wheel 2, which can be driven from outside, engages in first planet wheels 3, which are mounted in a first planet carrier 4. Three first planet wheels 3 are mounted in the first planet carrier 4, distributed across its width.

The first planet wheels 3 mesh in an internal gear 6, which is rigidly connected with the planet carrier of the third

stage III, defined here as the last planet carrier 5. The internal gear 6 and the last planet carrier 5 rotate at the same speed due to their rigid connection with one another. Second planet wheels 7, four of which are mounted across the width of an associated planet carrier 8 in the second transmission stage II, mesh in a second internal gear 13, which is rigidly connected in the same way as the first internal gear 6 with the last planet carrier 5, from the second transmission stage II. In the transmission axis, a second sun wheel 9, rigidly connected with the first planet carrier 3, engages in the second planet wheels 8 of the second transmission stage II.

A last sun wheel 10, connected rigidly with the second planet carrier 8, engages, from this carrier outward, in last planet wheels 11 of the last planet carrier 5 of the third transmission stage III. Four last planet wheels 11 are distributed over the width of this last planet carrier 5.

The last planet carrier 5 forms the driven shaft in a speed-reducing transmission.

The two first transmission stages I, II act functionally as if they are connected in series.

With the transmission described, a transmission ratio of $i = 181$, for example, can be achieved if the internal gears in which the planet wheels engage each have 108 teeth, the transmission ratios in the individual stages are $i_1 = 10$, $i_2 = 4$, and $i_3 = 5.5$, and in the last transmission stage, i.e. the third in this case (III), there are four planet wheels installed across its width, with only three planet wheels in each of the first two transmission stages.

In a transmission according to the invention which has the approximately the same volume as that known from EP 0 824

640 B1, but is slightly larger, an increase of more than 50 % in the torque to be transmitted can be achieved. In the same way, an increase of approximately 50 % in stiffness is also possible. These increases result, besides from the additional transmission stage, particularly from a use of four planet wheels in each of the two driven stages II, III, and from the selection of a transmission ratio of $i = 5.5$ in the transmission stages II, III, each of which are equipped with four planet wheels.

Naturally, the first transmission stage I can also be implemented with four planet wheels distributed across its width.

As in the known transmission according to EP 0 824 640 B1, the driven planet carrier is also in this case to be mounted on roller bearings inside the transmission housing 1 on both sides of the planet wheels it carries, and is to be axially fixed.

The individual planet wheels are mounted in the planet carriers with as little friction as possible in a way typical per se.

For transmission of higher moments, a three-stage transmission according to the invention can be advantageously designed as follows.

- All internal gears have a number of teeth $z = 108$.
- In the third transmission stage, four planet wheels are provided in the planet carrier distributed across its width and $i_3 = 5.5$ is set as the transmission ratio.
- In the second transmission stage, either four or three planet wheels are provided in the planet carrier

distributed over its width and $i_2 = 4$ or $i_2 = 5.5$ is set as the transmission ratio for this stage.

- In the first transmission stage, three planet wheels are provided in the planet carrier distributed over its width and $i_1 = 3, 4, 5, 7, 10$ can be set as the transmission ratio for this stage.

For an internal gear with $z = 108$ teeth, surprisingly, with a predetermined transmission ratio of $i = 5.5$, four planet wheels can be used in an associated planet carrier, distributed across its width. In spite of this odd single stage transmission ratio, an even overall transmission can be achieved through kinematics according to the invention.

A particular advantage is that, through the transmission kinematics according to the invention and possible individual or overall transmission ratios, in a three-stage transmission, for example, uniform reliability of the gearings can be achieved, which allows, in turn, high transmittable moments with, at the same time, low wear.

Only a slight, extremely damped noise emission issues outside the transmission housing from the rapidly running and therefore noise-intensive first two transmission stages. This is because the rotating parts of the first two transmission stages are not connected directly with the fixed transmission, and therefore, structure-borne noise issuing from them is only relayed over long paths with parting lines, which practically corresponds to a noise enclosure.

With a number of teeth $z = 108$ for the internal gears and transmission ratios of a maximum of $i = 10$ each in all three transmission stages, as well as three planet wheels distributed across the width in each transmission stage, a

maximum transmission ratio of $i = 901$ can be achieved according to the formula indicated above.

DESCRIPTION OF THE EMBODIMENT SHOWN IN FIG. 2

The difference in the embodiment shown in Fig. 2 relative to that shown in Fig. 1 is that the first and second internal gears 6, 13 are not rigidly connected with the last planet carrier 5, but with the transmission housing 1.

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CLAIMS

1. Planetary transmission having a first sun wheel (2), driven in a first transmission stage (I), which interacts with first planet wheels (3) of a first planet carrier (4) rolling in a first internal gear (6), a last planet carrier (5), driven in the last transmission stage (III) by a last sun wheel (10), which has last planet wheels (11) rolling in a last internal gear (12), and a fixed transmission housing (1), in which the last internal gear (12) of the last transmission stage (III) is rigidly connected with the transmission housing (1),

characterized in that

at least one further transmission stage (II), having a second sun wheel (9), a second planet carrier (8) with second planet wheels (7), and a second internal gear (13), is provided between the first (I) and last transmission stages (III) and the further transmission stages (II) are each connected in series with each other and with the first transmission stage (I), with the sun wheel (9) in each of the further transmission stages (II) being driven by the planet carrier of the preceding transmission stage, the planet carrier concerned driving the respective sun wheel of the following transmission stage (III), and the first and second internal gears (6, 13), in which the planet wheels (3 and 7) of the first and second transmission stages (I, II) each mesh, each being rigidly connected with the last planet carrier (5) or the transmission housing (I).

2. Planetary transmission with a design according to claim 1,

characterized in that

the driving and driven sides are interchanged.

3. Planetary transmission according to claim 1 or 2,

characterized in that

it is implemented with three stages.

4. Planetary transmission according to one of the preceding claims,

characterized in that

at least the last planet carrier (5) is provided with four planet wheels (11) across its width.

5. Planetary transmission according to claim 4,

characterized in that

only the last and next to last planet carriers (5, 8) are each provided with four planet wheels (11, 7) across their width.

6. Planetary transmission according to one of the preceding claims,

characterized in that

the transmission ratio in the transmission stages having four planet wheels (11, 7) distributed across the width of a planet carrier (5 and/or 8) is $i = 5.5$ with even transmission input and output speeds.

7. Planetary transmission according to claim 5,

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the transmission ratio is $i = 5.5$ in the last transmission stage and is $i = 4$ in the next to last transmission stage.

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: THOMAS BAYER -3 (PCT)

PCT No.: PCT/DE00/02693

FILED: AUGUST 10, 2000

TITLE: PLANETARY TRANSMISSION

PRELIMINARY AMENDMENT

BOX PCT

U.S. Patent and Trademark Office
P.O. Box 2327
Arlington, VA 22202

Dear Sir:

Preliminary to Examination, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, after the title, please insert as follows:

--CROSS REFERENCE TO RELATED APPLICATIONS

Applicant claims priority under 35 U.S.C. §119 of German Application Nos. 199 38 323.5 and 100 09 205.5 filed August 12, 1999 and February 26, 2000, respectively. Applicant also claims priority under 35 U.S.C. §120 of PCT/DE00/02693 filed August 10, 2000. The international application under PCT article 21(2) was not published in English.--

Replace page 1 of the specification by new pages 1 and 1a attached hereto as Exhibit A.

IN THE CLAIMS

Please replace original claims 1-7 with new claim 8 as attached hereto as Exhibit B.

Please add the Abstract, attached hereto as Exhibit C.

REMARKS

By this Preliminary Amendment, a cross-reference to related applications has been inserted in page 1. Original page 1 is being replaced with new pages 1 and 1a. Replaced original claims 1-7 with new claim 8, and an Abstract is being provided. No new matter has been introduced. Entry of this amendment is respectfully requested.

Respectfully submitted,
THOMAS BAYER

By: 

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Enclosure: Exhibits A, B, and C

EXPRESS MAIL NO. EL 871 451 760 US

Date of Deposit: February 8, 2002

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10, on the date indicated above, and is addressed to BOX PCT, U.S. Patent and Trademark Office, P.O. Box 2327, Arlington, VA 22202.


Lisa L. Vulpis

EXHIBIT A

NEW PAGES 1 AND 1A

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PLANETARY TRANSMISSION

The invention concerns a planetary transmission according to the generic portion of the single patent claim.

This type of transmission is known, in relation to the alternative in which the internal gears of the first and second stages are rigidly connected with the planet carrier of the third stage, from DE 198 40 968 A1, and, in relation to the alternative in which the internal gears of the first and second stages are rigidly connected with the transmission housing, from GB 627,004 A.

In relation to the previously cited prior art which forms the generic portion, the invention concerns itself with the problem of being able to achieve a high transmission ratio, with large torques and high transmission stiffness at the same time, having the smallest possible overall volume. At the same time, the transmission should be economically producible with simple means and should ensure a durable, low-wear operation with low-play transmission.

This object is achieved according to the invention by a planetary transmission according to the generic portion with the characterizing features of the single patent claim in a surprisingly good and simple way.

An essential core of the invention is the use of internal gears each having a number of teeth, typical for various reasons in planetary transmissions, of $z = 108$ and the realization of a transmission ratio of $i = 5.5$, not typical in planetary transmissions, in the third and therefore last driven stage with the simultaneous use of four planet wheels. This type of non-whole number transmission ratio is not typical, because typically in transmission technology, only whole number transmission ratios are realized for other normalization reasons.

If four planet wheels and a number of teeth in the internal gears of $z = 108$ are used, a maximum torque transmission can surprisingly be achieved with a transmission ratio of precisely $i = 5.5$.

The whole number transmission typical in transmissions is achieved overall by the combination of the transmission ratios of $i = 4$ in the second transmission stage and $i = 5.5$ in the third transmission stage.

In a speed-reducing transmission, the driven transmission stage is loaded with the highest torque, so that it is important that precisely this last stage be implemented for optimum reception of a high torque. Through the design indicated according to the invention of the second and third transmission stages, planetary transmissions having a small overall volume and, simultaneously, high torques to be transmitted are created in a surprisingly good way, with, additionally, extremely high transmission stiffness.

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EXHIBIT B

NEW CLAIM 8

NEW CLAIM

8. Three stage, speed-reducing planetary transmission having, in each stage, a driven sun wheel rolling in an internal gear and interacting with a planet wheel mounted in a planet carrier, in which the sun wheels of the second and third stages are each driven by the planet carrier of the preceding stage, and a fixed transmission housing, in which at least the internal gear of the third stage is rigidly connected with the transmission housing and the internal gears of the first and second stages are each rigidly connected either with the planet carrier of the third stage or the transmission housing, and in which, furthermore, the planet carriers of the second and third stages are each provided with four planet wheels across their width, characterized by the features
- the internal gears (6, 12, 13) each have a number of teeth $z = 108$ in all three stages,
 - the transmission ratios are $i = 4$ for the second stage and $i = 5.5$ for the third stage.

EXHIBIT C

ABSTRACT

[illegible][illegible]

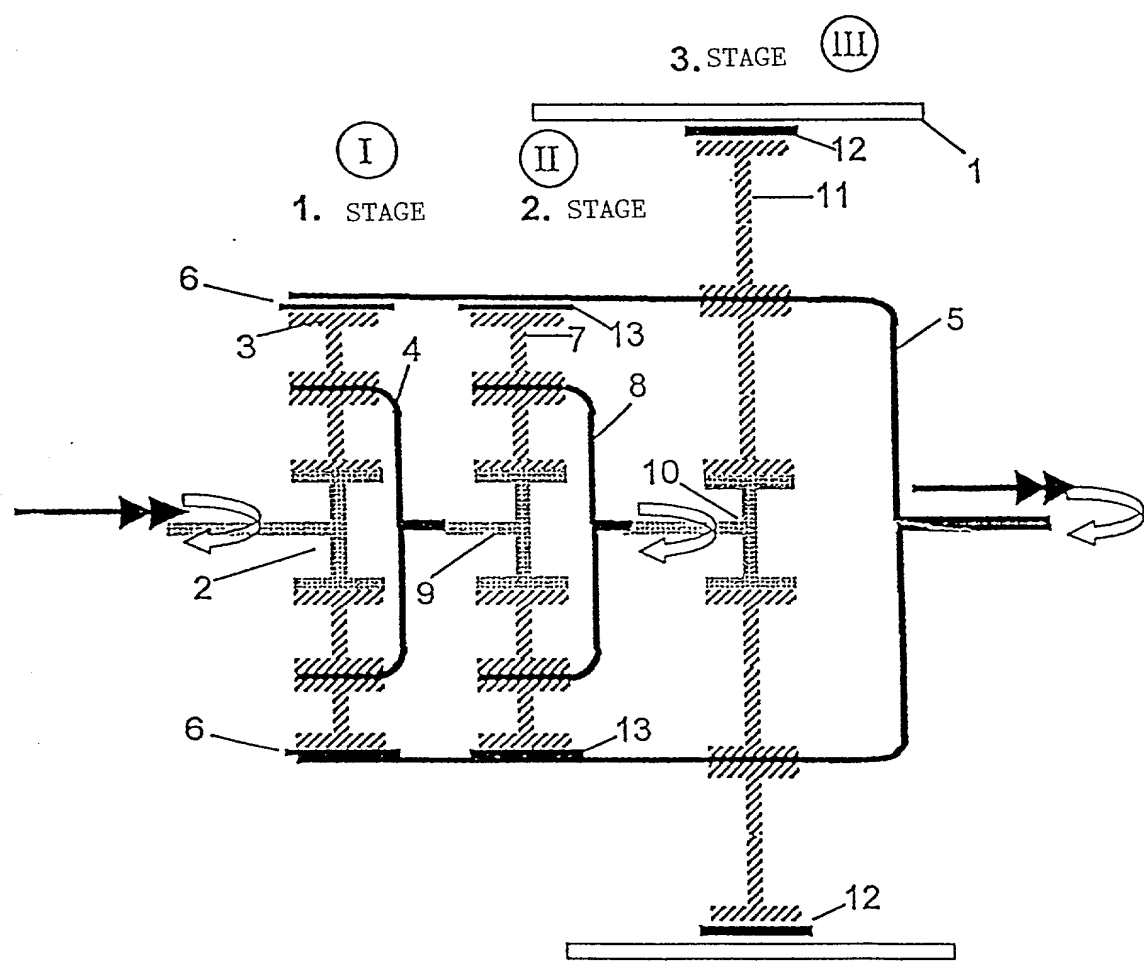


Fig. 1

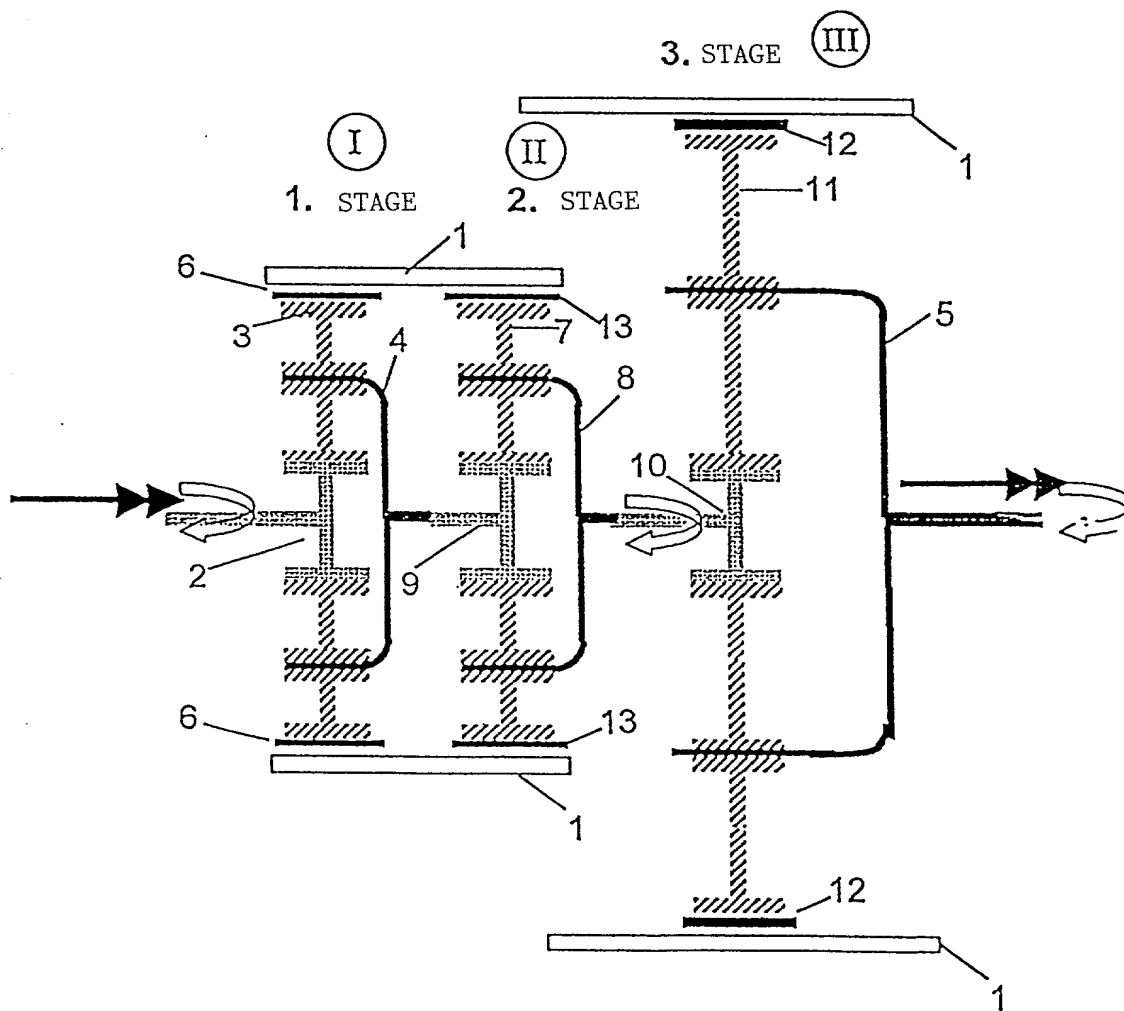


Fig. 2

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(Includes Reference to PCT International Applications)

ATTORNEY'S DOCKET NUMBER
BAUER-3 PCT

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

PLANETARY TRANSMISSION

the specification of which (check only one item below):

- ☐ is attached hereto.
- ☐ was filed as United States application
Serial No. _____
on _____,
and was amended
on _____ (if applicable).
- ☒ was filed as PCT international application
Number PCT/DE00/02693
on 10 AUGUST 2000,
and was amended under PCT Article 19
on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. 119
GERMANY	199 38 323.5	12 AUGUST 1999	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
GERMANY	100 09 205.5	26 FEBRUARY 2000	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)				ATTORNEY'S DOCKET NUMBER BAUER-3 PCT	
I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.					
(Application Number)		(Filing Date)			
I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclose in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:					
PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:					
U.S. APPLICATIONS			STATUS (Check One)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED	
PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			
POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (List name and registration numbers):					
<div style="display: flex; justify-content: space-between;"> <div> KURT KELMAN, Registration No. <u>18,628</u> ALLISON C. COLLARD, Registration No. <u>22,532</u>; EDWARD R. FREEDMAN, Registration No. <u>26,048</u>; ELIZABETH COLLARD RICHTER, Registration No. <u>35,103</u> </div> <div> WILLIAM C. COLLARD, Registration No. <u>38,411</u>; FREDERICK J. DORCHAK, Registration No. <u>29,298</u>; ROBERT W. GRIFFITH, Registration No. <u>48,956</u> </div> </div>					
Send Correspondence to: <u>COLLARD & ROE, P.C.</u> <u>1077 Northern Boulevard</u> <u>Roslyn, New York 11576</u>			Customer No. <u>25889</u>		Direct Telephone Calls to: (name and telephone number) <u>(516) 365-9802</u>
2	FULL NAME OF INVENTOR	FAMILY NAME <u>BAYER</u>	FIRST GIVEN NAME <u>THOMAS</u>		SECOND GIVEN NAME
0	RESIDENCE & CITIZENSHIP	CITY <u>IGERSHEIM</u>	STATE OR FOREIGN COUNTRY <u>GERMANY</u> DEX		COUNTRY OF CITIZENSHIP <u>GERMANY</u>
1	POST OFFICE ADDRESS	POST OFFICE ADDRESS <u>HOLZÄCKERWEG 5</u>	CITY <u>D-97999 IGERSHEIM</u>		STATE & ZIP CODE/COUNTRY <u>GERMANY</u>
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.					
SIGNATURE OF INVENTOR 201 					
DATE <u>5.11.2007</u>					